

This is a list of the equipment within the Ames Laboratory's Materials and Engineering Physics Program. Availability of the research equipment is dependent upon the individual research group schedules, Program and Ames Laboratory research priorities. Principle Investigators with controlling interest in the specific equipment will have ultimate authority to approve of proposed use of the equipment. As equipment is added and decommissioned yearly this list may omit some current holdings or list recently decommissioned equipment.

For more information concerning specific items listed, please contact MPC and you will be put in touch with the proper parties. Send correspondence to Director, Materials Preparation Center, Ames Laboratory, 121 Metals Development, Ames, IA, 50011-3020, Phone (515) 294-5236, Fax (515) 294-8727. Last updated: 9/11/06.

Directional Solidification

- Liquid-metal cooling DS units (3)
 - Temperatures up to 1100°C
 - Nominal thermal gradients ~1-10K/mm
 - Growth rates 4×10^{-7} to 2 m/s
 - Specimen dimension range: dia. (0.1mm to 6mm), length (up to 300mm)
 - Maximum growth length (150mm)
- High temperature DS unit
 - Temperatures up to 1850°C
 - Growth rates 4×10^{-7} to 2 m/s
 - Rapid quench capability
- Transparent material 2D DS units (3)
 - Temperatures up to 400K
 - Temperature gradient up to 12K/mm
 - Growth velocity contro $\pm 5 \times 10^{-8}$ m/s
 - In-situ digital imaging at 1×10^{-7} m and 1s resolution
 - Digital and analog video capability
- Transparent material 3D DS unit
 - ITO coated quartz tube heating
 - Peltier cooling
 - Temperature gradient: up to 4K/mm
 - Growth velocity: as low as 0.5 μ m
 - Axial and lateral cameras
- Transparent material 3D-constrained DS unit
 - Single cell/dendrite growth in a channel of ~100 μ m ID

Transparent-organic preparation facilities

- Evaporation/Sublimation distillation columns
- 10-stage zone refining units (2)
- Optical refractometer
- Melting-point measurement system
- Glovebox for sample preparation in controlled atmosphere
- APX-100 analytical balance (max. weight: 100g; precision: 0.1mg)
- Crystal orientation selection setup

Interfacial Property Measurement

High temperature grain boundary groove furnace
Transparent-organic grain boundary groove stage

Characterization Facilities

Zeiss Axiovert inverted stage microscope
Metallographic specimen preparation lab (standard equipment)
Leica Polycut Micromilling unit

Crystal Preparation and Characterization Facilities

Resistance Heated Bridgman Crystal Growth Systems
Czochralski Crystal Growth System
Tri-arc Czochralski Crystal Growth System
Optically Heated Float Zone Crystal Growth System
Arc Zone Melting Crystal Growth System
Back-Reflection Laue X-ray System
Spark Planing Electro-Discharge Machining
High and Low speed Diamond Saws
Lapping Fixtures for Precise Orientation of Crystals (0.1°)

Microanalysis Facilities

FEI-Tecnai G2-F20 Scanning Transmission Electron Microscope
Phillips CM30 Scanning Transmission Electron Microscope equipped
with thin window EDS, Hot, cold and vacuum stages. Parallel Electron
Energy Loss Spectrometer
JEOL 5910 SEM equipped with SE and BSE Detectors and EDS capabilities
JEOL 8200 Automated Electron Microprobe with 5 wavelength dispersive spectrometers (WDS), integrated
EDS system, and high-precision stage for large samples
Amray 1845 FEG scanning electron microscope with SE and BSE imaging, thin
window EDS, and Orientation Imaging Microscopy accessory
Complete SEM and TEM sample preparation facilities

Surface Characterization Facilities

JEOL JAMP-7830F Auger Microprobe with Hemispherical Mirror Analyzer,
Cooling/heating stage, fracture stage and ion depth profiling
Reflected Electron Energy Loss Spectroscopy and Microscopy

Powder Preparation, Handling, Forming and Characterization Facilities

High Pressure Gas Atomizer (HPGA)
Industrial Prototype HPGA
Centrifugal Atomizer
Rapid Solidification Melt Spinner Furnace
High Energy Mechanical Alloying Attritors
Vacuum Hot Press (40 Ksi, 1500°C)
Vacuum Hot Press (75 ton, 2200°C)
Cold Isostatic Press (100 Ksi)



Hot Isostatic Press (45 Ksi, 2000°C)
Twin Screw Extruder
Single Screw Injection Molder
Sintering Furnace System
Inert Atmosphere Glove Box Handling Facilities
Acucut Pneumatic Classifier
Cyclotex Pneumatic/Closed Loop (air classifier)
Automated Woven Mesh Sieving System
Sub-sieve Sonic Sifter
Multi-axis Eccentric Powder Blender
Microtrac Automated Particle Size Distribution Analyzer
Pycnometer
Powder Flowability Testing
Tap Densities Testing
Rheometer
1/2 gal. Sigma Blade Mixer
Brinkman Viscosity Tester
Gilson Spinning Riffler 1 l & 5 l cap.
Beckman-Coulter submicron particle size analyzer
Spex 8000 mixer mill (mechanical alloying)

X-Ray Facilities

Philips X-ray Generators with the following accessories:
Texture Goniometer
 θ - 2θ Diffractometer
 θ - θ Diffractometer
Powder Diffractometer
Scintag X-ray Diffractometer (room temp.)
Rigaku rotating anode X-ray Diffractometer 4K to 300K @ 0 to 35 KOe; 1000°C powder diff.
PANalytical X-Pert Pro Diffraction System, w/furnace stage, X-Y-Z-Psi-Phi Stage

Physical Properties Measurement Facilities

Semi-adiabatic calorimetry, 3K to 350K @ fields to 100 kOe
Calorimetry, 3k to 350k @ fields to 10 T for heat capacity
Ac/dc Electrochemical measurements @ 300K for corrosion properties, Impedance spectroscopy
Perkin-Elmer Differential Thermal Analyzer (DTA)
Perkin-Elmer Thermogravimetric Analyzer (TGA)
Perkin-Elmer Pyris I Differential Scanning Calorimeter (DSC)
Resistivity Measurements (2 to 1200 K)
Vickers and Rockwell Hardness Testing
Salt Fog Corrosion Resistance Testing
Heat capacity (350K to 1K)
Electrical conductivity (room temp. to 1000°C)
Thermal electric power (room temp. to 1000°C)

Thermal diffusivity (room temp. to 1000°C)

Hall effect (room temp.)

Ultrasonic inspection and characterization (velocity, attenuation, flaw detection, harmonic generation), 25°C to 600°C

Sample Preparation Facilities

Zeiss Axiomat Optical Microscope

Fully Equipped Metallographic Laboratory

2 Ion Millers

2 Dimplers

Sputter Coater

Spark Cutter

Evaporator

2 Electropolishers

Darkroom Facilities

High speed diamond wheel dicing saw

Gatan Cryoplunge

Leica Ultra Microtome low temperature sectioning

Carbon coater

Primary Fabrication Facilities

100 ton Stanat rolling mill (rod and flat rolling)

6" Reeves rolling mill

100 ksi, 1.125" extrusion press

1" bore hydrostatic extrusion press

700 ton Loewy Hydro extrusion press

300 ton Baldwin press

5 Rotary Die Swaging Machines (2 Fenn, 1 Lancelier, 2 Torrington) 1.25" to 0.014"

12.5 ton, 10 ft Loma hydraulic wire drawing bench

1.2 ton, 8 ft hydraulic wire drawing bench

Secondary Fabrication Facilities

Completely equipped machine shop with EB and TIG welding capabilities

Mechanical Testing Facilities

100kN MTS Model 810.22 servo-hydraulic high temperature flexure/compression test unit capable up to 1600C in air

100kN MTS Model 810.22 servo-hydraulic high temperature tensile test unit capable up to 1600C in N₂ gas or in argon

100kN INSTRON Model 4505 electro-mechanical high temperature punch/flexure/compression test unit capable up to 800C in air

50kN INSTRON Model 1321 servo-hydraulic high temperature compression/flexure test unit capable up to 1600C in N₂ gas

1000kN MTS Model 311.31 servo-hydraulic tensile/fracture mechanics test unit

100kN INSTRON Model 1125 electro-mechanical compression/tension/flexure test unit

"Dead-load" ATS tensile creep test unit capable up to 1000C in air.



Stress Analysis Unit (strain gage based)

Pure Metal and Alloy Preparation Facilities

150 kW plasma furnace, 4" ingot
60 kW Electron beam melting furnace
9 kW Electron beam melting furnace
Non-consumable arc melting/casting furnaces
Vacuum arc melting/remelting furnaces (VAR)
100 lbs. Bottom pour chill casting induction furnace
10 lbs. Bottom pour chill casting induction furnaces
50 lbs. vacuum induction tilt-pour induction furnace
1900°C Tungsten vacuum furnaces
1000°C resistance vacuum furnaces
1200°C controlled atmosphere furnaces
1500°C SiC box furnaces
1000°C resistance box furnaces
1250°C resistance box furnace

Pure Metal and Alloy Preparation Facilities (cont.)

Resistance heated vacuum distillation/sublimation furnaces
Electrotransport purification furnaces
1500°C Oxy-Gon Quick Quench Furnace
2250 psi High Pressure Hydrogen Charging furnace
Low Pressure Hydrogen Charging furnaces
1000°C Hydrofluorination furnaces
Tantalum fabrication and welding facilities
Ultra high purity glove boxes (handling of rare earths)
HV & UHV furnaces (distillation and sublimation of rare earth metals)
Spex 8000 mixer mill (mechanical alloying)
2000°C high vacuum, 75 ton, Centorr Hot Press

Analytical Facilities

Thermal Gravitational Analyzer-Cahn 131 (Oxidation Measurements)
Thermo Jarrell IRIS ICP-AES
Horiba EMIA-520 Carbon/Sulfur Analyzer
Leco TC-436 Nitrogen/Oxygen Determinator

Surface Coating/Plasma Spraying Facilities

Plasma Arc Spray System (atmosphere and pressure controlled)
High-Velocity Oxygen-Fuel Coating System

Thin Film Deposition Facilities

INDEL Systems Ion Beam Thin film Deposition System
Cryopumped vacuum system, capable of low 10^{-7} Torr
Two rf-based 10 cm ion guns (main and assist)
Six 8-inch sputtering targets on carousel



Two mass-flow controlled gas lines to each ion gun, one to chamber
 Substrate holder for 3 inch or 4 inch Si wafers
 Rotating
 Water-cooled or heated (maximum 300°C)
 Capability to apply magnetic field of 100 Oe during field growth
 Quartz-oscillator thickness monitor
 Residual gas analyzer
 Capable of reactive deposition of oxides and nitrides

Tribology Equipment

Falex ISC-450 Pin-on-disc tribometer with 600°C temperature capability and humidity control.
 Hommel T-8000 Profilometer with automated 3-d surface profiling and extended software capabilities
 Dry-sand-rubber-wheel abrasion tester for ASTM G-65

Magnetic Properties Measurements Equipment

Hysteresisgraphs

Magnescope Mark I, Magnescope Mark II
 Hysteresisgraph

Barkhausen effect instrumentation

Magneprobe
 STRESSCAN - 500C

Magnetic Measurement

AFM/MFM-Scanning Probe Atomic and Magnetic Force Microscope
 0 to 700 Oe. in-plane applied magnetic field
 -10°C to 50°C sample temperature
 capability to measure magnetoresistance and magnetic domain images
 simultaneously

Magnetic Torque Sensor test bed 0 to 700φ in-plane applied field -10°C to 50°C measurement
 -40°C to +95°C sample temperature
 -10 to 10 N•m applied torque
 0 to 30 Oe, applied magnetic field

Magnetic Core Loss measurement workstation

Vibrating Sample Magnetometer
 -7.5 kOe to +7.5 kOe applied magnetic field
 20°C to 1000°C sample temperature

Programmable Single Phase Digital Power Analyzer

Electromagnets

Magnetic Modeling software

Magnetic Field (H) measuring instruments

Magnetic Induction (B) measuring instruments

Strain Indicators/Strain Gauge Bridge

Ac/dc Magnetic susceptibility/magnetization/resistivity, 4.2K to 320K @ fields to 5.6 T

Ac/dc Magnetic susceptibility 1.5K to 800k @ fields to 9 T

Squid Magnetometer

Magnetic susceptibility (room temp. to 1K)

Magnetostriction and thermal expansion, 10K to 600K @ fields up to 2.5 T

Ultrasonic Testing Equipment

Ritec SNAP 5000 System

Panametrics 5052 PRX pulser/receiver

Lecroy 9310L Broadband Oscilloscope

Matec 5100 Gated Amplifier

This equipment combined with data processing software, is used for transmission and reception of ultrasound, and is useful in making ultrasonic velocity and attenuation measurements. Ultrasonic velocity measurements are useful in calculating the Young's, Bulk, and Shear Moduli of materials, and also Poisson's ratio. Measurement of velocity and/or attenuation (when the probes are scanned over the sample in a raster fashion) may be used to map out local variations in density (porosity) in a sample. This equipment is also used for nonlinear acoustic measurements of bulk materials, and is also capable of locating internal flaws or discontinuities, cracks, etc., in the range of approximately 0.25 mm dia. and larger.